GARY R. HERBERT
Governor
GREG BELL
Lieutenant Governor

State of Utah
DEPARTMENT OF NATURAL RESOURCES
MICHAEL R. STYLER
Executive Director
Division of Water Rights
KENT L. JONES
State Engineer/Division Director

February 19, 2013

RE: Stream Channel Alteration No. 13-57-08SA
Red Butte Creek
Chevron Pipe Line Company

Attached is a copy of an application to alter a natural stream, which has been submitted to the Division of Water Rights (Division) for processing.

In processing this application, the Division will work to determine if the project will:

- Unreasonably or unnecessarily affect any recreational use or the natural stream environment;
- Unreasonably or unnecessarily endanger aquatic wildlife;
- Unreasonably or unnecessarily diminish the natural channel's ability to convey high flows; or
- Impair vested water rights.

Any decision made regarding this application will be based exclusively on these four criteria. If you have information regarding these four criteria that will aid the Division in making a determination and subsequent decision, please submit this information, in writing, to this office prior to **March 11, 2013**. For questions or comments pertaining to all other aspects of the project, please contact the applicant listed on the front page of the application directly.

Sincerely,

for Tiffany Gonzales
Chuck Williamson, P.G.
Stream Alteration Specialist

Pc: Richard Clark - EPA
Corps of Engineers
Supervisor - U. S. Fish & Wildlife
Teresa Wilhelmsen - Regional Engineer
Mark Farmer - Regional Wildlife Habitat Manager
Carmen Bailey - Aquatic Habitat Coordinator
Bill Damery - DEQ, Water Quality Division
Laura Ault - Forestry Fire & State Lands
Kelly Beck - RDCC Coordinator
State Parks & Recreation
Lori Hunsaker - State History
W. D. Robinson - Department of Agriculture
Judy Watanabe - CEM
Chris Springer - Salt Lake County

1594 West North Temple, Suite 220, PO Box 146300, Salt Lake City, UT 84114-6300
telephone (801) 538-7240 • facsimile (801) 538-7467 • TTY (801) 538-7458 • *www.waterrights.utah.gov*

UTAH DNR WATER RIGHTS

Rec. by CHWC
Fee Rec. $2,000
Receipt # 13-00620
CHK No. 25632

JOINT PERMIT APPLICATION FORM

U.S ARMY CORPS OF ENGINEERS – FOR SECTIONS 404 AND 10
UTAH STATE ENGINEER'S OFFICE – FOR NATURAL STREAM CHANNELS

Application Number (assigned by): Corps / 13-57-08SA State Engineer

Applicant's Name (Last, First M.I. or entity if not an individual)	Authorized Applicant Representative (if any)	Applicant's Telephone Number and Area Code / Representative's Telephone Number and Area Code
Chevron Pipe Line Company	EarthFax Engineering, Inc.	801-975-2353 / 801-561-1555

Applicant's Address (Street, RFD, Box, Number, City, State, Zip)
2875 S. Decker Lake Drive, Suite 150
Salt Lake City, Utah 84119

X: 429230.14 **PROJECT LOCATION** Y: 4511395.89

Quarter Section(s)	Section	Township	Range	Base & Meridian
NW NE ¼ and SW ¼	9	T. 1 S.	R. 1 E.	SLB&M

County	Associated Watercourse or Watercourse to be Altered	Check one: ☒ Within City Limits ☐ Outside City Limits List town or nearest town:
Salt Lake	Red Butte Creek	Salt Lake City

Project location or address:
Site #37, approximately 1780 E. Sunnyside Avenue
Site #58, approximately 1560 E. Bonneview Drive

Brief description of project including methods and equipment to be employed to complete the work:
Site #37 located on creek in Sunnyside Park (40° 45'37.3" N, 111° 50'20.2" W) in Salt Lake City, Utah. Site #58 located on creek in Bonneville Glen Park (40° 44'47.1" N, 111° 50'46" W). Work will include placing approximately 5 cy of riprap (2 cy at Site #37 and 3 cy at Site #58). Hand tools and small motorized equipment will be used outside of the channel. Design calculations and work plans are attached.

Purpose (justification) of project:
Repair of existing storm drain channel (Site #37) and repair of creek bank (Site #58) to prevent further erosion.

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SALT LAKE

Is this a single and complete project or is part of a larger project, continuing project, or other related activities? If so, please describe the larger project or other related activities.
Single repair projects.

If project included the discharge of dredged or fill material into a watercourse or wetland:

Cubic yards of material: Approximately 5 cy total (Site #37 = 2cy; Site #58 = 3 cy)

Acreage or square footage of waters of the United States affected by the project: Approximately 150 sf (Site #37=60sf; Site #58=90sf)

Source and type of fill material: Class II & III riprap from local source along with on-site rock.

Length of stream that will be impacted below ordinary high water elevation: Site #37=4 ft; Site #58=30 ft

Alternatives (other ways to accomplish project purpose):

Both site areas are protected with riprap/natural rock. Proposed repairs at both sites are "Repair in Kind". No other mitigation systems were evaluated.

Describe any proposed mitigation to offset impacts to the stream channel.

Work will occur during low streamflow conditions. Riprap will be placed such that it does not protrude into the channel or alter the downstream flowline or hydraulics of Red Butte Creek.

Cultural resource impacts:

Are you aware of any cultural resources or any historic properties that will be impacted by the proposed project? ☐ Yes ☒ No
If Yes, please explain:

Has a cultural resource survey been conducted on the property where the proposed project is to occur? ☐ Yes ☒ No
If Yes, please briefly explain the survey results:

List other authorizations required by Federal, state, or local governments (i.e.: National Flood Insurance Program), and the status of those authorizations.

Flood control permits have been requested from Salt Lake County along with riparian corridor permits from Salt Lake City Public Utilities. These requests are currently under review.

Estimated starting date of project:	Estimated completion date:
February 2013	July 2013

Please complete the following checklist

Failure to indicate that all pertinent information has been submitted will result in your application being returned.

- ☒ Appropriate application processing fee payment (see fee schedule below).
- ☒ A clear site location map with enough detail to easily find the site, a recent aerial/satellite image of the site, and a USGS topography map (7.5 minute quadrangle map is recommended).
- ☒ Plan view and cross-sectional drawings showing all work requiring a permit, including fills, structures, borrow sites, staging areas and storage areas. The drawings must clearly demarcate the ordinary high water mark of the waters of the U.S. to be impacted. Professional drawings are not required; however, drawings must be scaled or indicate dimensions of the work to be completed.
- ☒ A restoration plan for any areas temporarily disturbed during work, including re-contouring, revegetation with appropriate native plants and maintenance and monitoring to ensure success for the restored area.
- ☒ Ground photographs taken from various locations of the proposed disturbance area.
- ☒ Please check the box if the proposed project involves bank stabilization or protection. If so, please complete the following:
  - ☒ A narrative demonstrating the proposed activity incorporates the least damaging bank protection methods. These methods include, but are not limited to, the use of bioengineering, biotechnical design, root wads, large woody debris, native plantings, and beach nourishment in certain circumstances. If rock must be used due to site erosion conditions, explain how the bank stabilization structure incorporates elements beneficial to aquatic organisms.

- ☒ A description of current and expected post-activity sediment movement and deposition patterns in and near the activity area.
- ☒ A description of current and expected post-activity habitat conditions, including the presence of fish, wildlife and plant species in the activity area.
- ☒ An assessment of the likely impact the work would have on upstream, downstream and cross-stream properties (at a minimum the area assessed should extend from the nearest upstream bend to the nearest downstream bend of the watercourse). Specifically, discuss how the project will impact the following:
  - Will the activity accelerate deposition or erosion?
  - Will impacts to sensitive species or habitats result from a change in suspended sediment load or turbidity?
  - Will the activity affect the diversity of the channel by eliminating in-stream habitat, meanders, or gravel bars?
  - Will the activity result in a shift in the main flow patterns?
- ☒ A planting plan which involves the use of native riparian plants, unless the applicant demonstrates it is not appropriate or not practicable.

Application is hereby made for a permit or permits to authorize the activities described herein. I certify that I am familiar with the information contained in the application, and that to the best of my knowledge and belief, such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities or am acting as the duly authorized agent of the applicant which is a **(check one of the following) commercial ☐, non-commercial ☐, or governmental ☐ entity.**

Signature of Applicant Lloyd Watkins Date: Feb 7th, 2013

Lloyd Watkins, SERIP Advisor

I hereby certify that EarthFax Engineering, Inc. is acting as my agent on this project.

Agent's address and telephone number: 7324 S Union Park Ave, #100, Midvale, Utah 84047 801-561-1555

Filing Instructions

Application supplements should be submitted on paper no larger than 11 x 17 inches or alternatively as PDF format electronic files. If more than one watercourse is to be altered as a result of the project, a separate application must be submitted for each watercourse. Application fees must be received by the Division of Water Rights at the time of application submission and must be either hand delivered or submitted through standard mail.

Application Processing Fees

Application fees are based on the type of entity applying for the proposed stream alteration project.

Commercial Entities:	$2000.00	per application processed.
Non-Commercial Entities:	$100.00	per application processed.
Governmental Entities:	$500.00	per application processed.

Red Butte Creek Repairs
LDS Church Sites
Design Summary Report

Chevron Pipe Line Company
Salt Lake City, Utah

October 2012

EarthFax Engineering, Inc.
Engineers / Scientists
7324 South Union Park Avenue, Suite 100
Midvale, Utah 84047
USA
801-561-1555
www.earthfax.com

Red Butte Creek Repairs
LDS Church Sites
Design Summary Report

Chevron Pipe Line Company
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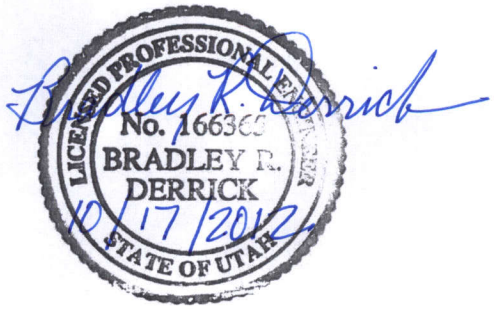
October 2012



EarthFax EarthFax Engineering, Inc.

Engineers / Scientists
www.earthfax.com

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

REPAIRS TO RED BUTTE CREEK – LDS CHURCH SECTIONS
DESIGN SUMMARY REPORT

CHAPTER 1
INTRODUCTION

The cleanup and recovery operations along Red Butte Creek following a June 2010 crude oil release have been determined to have damaged a storm drain outfall channel and a section of stream bank along Red Butte Creek (Creek) on property belonging to the Church of Jesus Christ of Latter-Day-Saints (Church) in Salt Lake City, Utah. The damage was further exacerbated during the high flow runoff volumes from winter snow melt during the spring of 2011. To preclude future erosion of the storm drain channel and creek bank at these two locations, Chevron Pipe Line (CPL) has agreed to work with the Church, Salt Lake County (County), and Salt Lake City (City) to repair the outfall channel and stabilize Creek bank at each location.

1.1 Storm Drain Outfall (Site #37)

The location of the storm drain outfall, marked as "VA of 4," is shown in the aerial photograph as Site #37 on page 1 of 4 in Attachment A. A photograph of the outfall headwall storm drain channel taken by Bio-West as Part of their Red Butte Creek Post-Oil Release Stream Channel, Physical Habitat, and Riparian Vegetation Evaluation Final Report is shown on page 2 of 4 in Attachment A. Access to the site requires travel down the west bank from accessed roadways, as shown in the aerial photograph, within an adjacent City park (Sunnyside Park).

1.2 Creek Bank (Site #58)

The location of the Creek bank repairs is shown in the aerial photograph as Site #58 on page 3 of 4 in Attachment A. A photograph of the bank and adjacent pathway was taken by Bio-West as Part of their Red Butte Creek Post-Oil Release Stream Channel, Physical Habitat, and Riparian Vegetation Evaluation Final Report are shown on page 4 of 4 in Attachment A. Access to the site is gained from the parking area and walking pathway adjoining 1500 East and Bonneview Drive as shown in the aerial photograph.

This document was prepared by EarthFax Engineering, Inc. (EarthFax) in conjunction with Bio-West, Inc. (Bio-West) to summarize the methods and calculations used to design the storm drain channel and creek bank repairs for permitting of the proposed repair work at the sites.

CHAPTER 2
DESIGN APPROACH

2.1 EXISTING CONDITIONS

2.1.1 Storm Drain Outfall (Site #37)

Runoff enters the Red Butte Creek through a storm drain outfall structure (VA of 4) and open channel from the VA Hospital and Sunnyside Park in Salt Lake City, Utah. The Creek channel in this area consists generally of near vertical soil and rock banks approximately 2.5 feet in height and then variable slopes of approximately 2:1 (see page 1 of 4 in Attachment B). The Creek is approximately 5.8 feet wide across the bottom of the channel and 7.6 feet across at the top of the vertical banks. The average slope of the main channel is 0.032 feet per foot (ft/ft) with a local slope of 0.028 ft/ft as measured in the Bio-West Study (see Table 2 – Summary of Streambed Material, Channel Geometry, and Slope Data. The upper banks on both sides of the channel, west and east, typically consists soil and vegetative cover. The bottom of the channel is lined with cobble of varying size.

The 18-inch storm drain outfall (headwall) structure has an apron that is approximately 6 feet long, 5 feet wide at the end, and approximately 8-inches deep for energy dissipation. The storm drain channel leading running from the headwall to the Creek is a trapezoidal channel approximately four feet wide with rocky bottom and sides. The end of the channel drops approximately 2.5 feet down the bank into the Creek (see page 2 of 4 in Attachment B).

It is believed that cleaning activities damaged vegetation and shifted rocks that previously stabilized the bank at the inlet to the channel which allowed the heavy spring runoff of 2011 to cause additional movement of these rocks and erosion of the bank and drainage channel riprap.

2.1.2 Red Butte Creek (Site #58)

This section of Red Butte Creek runs through Bonneville Glen Park adjacent to the Bonneville Stake Center building in Salt Lake City, Utah. The Creek channel in this area consists generally rock protected or soil and rock banks with shelves approximately two to three feet in height. Pathways and variable slopes of approximately 2H:1V (see page 3 of 4 in Attachment B). The Creek is approximately 10 feet wide across the bottom of the channel and up to 16 feet across at the top of the banks. The average slope of the main channel is 0.036 ft/ft with a local slope of 0.021 ft/ft as measured in the Bio-West Study (see Table 2 – Summary of Streambed Material, Channel Geometry, and Slope Data. The upper banks on both sides of the channel, west and east, typically consists of soil and vegetative cover. The bottom of the channel is lined with cobble of varying size.

It is believed that cleaning activities damaged vegetation and shifted rocks that previously stabilized the bank at the inlet to the channel which allowed the heavy spring runoff of 2011 to cause additional movement of these rocks and erosion of the bank rock protection.

2.2 HYDROLOGIC METHODS AND CALCULATIONS

2.2.1 Storm Drain/Channel Flow and Velocity (Site #37)

The maximum water velocity and flow from the storm drain outlet were modeled using FlowMaster Version 6.0. This model evaluates conditions based on the solution of Manning's one-dimensional energy equation (Eq. 2-1):

$$v = \frac{1.49}{n} R^{2/3} S^{1/2}$$

where v = average velocity of flow at a given cross section (ft/s)

R = hydraulic radius of the cross section (ft)

S = slope of the pipe (ft/ft)

n = Manning's roughness coefficient

The solution of this equation requires data concerning the pipe slope, pipe cross section, and roughness coefficient for the pipe. The pipe type and diameter are based on site observations and measurements (See page 1 and 2 of 4 in Attachment B). Slope of the drain was assumed to be at a minimum for self-cleansing velocity and topographic data from existing mapping of the site. Based on a review of site conditions and typical values for reinforced concrete pipe, the following values were used for the storm drain:

Pipe Diameter (Inches): 18

Pipe Depth (R): 1.5 (Pipe flowing full)

Pipe Slope (S): 0.012

Pipe Type (n): 0.013

Therefore, the peak flows anticipated from the storm drain outfall is approximately 12 cubic feet per second (cfs), see pages 1 and 2 of 10 in Attachment C. The existing configuration of the outfall structure has as concrete stilling basin to aid in the dissipation of energy in the flow prior to the water entering the outflow channel running to the Creek. Once the stormwater exits the pipe, flow in the channel is also evaluated using Equation 2.1 to size riprap for the proposed repairs. The depth of water and velocity of flow in the storm drain channel was modeled using FlowMaster Version 6.0 for the anticipated maximum flow of 12 cfs. Using Manning's equation (Eq. 2-1) above where:

v = average velocity of flow at a given cross section (ft/s)

R = hydraulic radius of the cross section (ft)

S = slope of the water surface (ft/ft)

n = Manning's roughness coefficient

The solution of this equation requires data concerning the channel cross section as well as an estimate of the roughness coefficient. A profile of the storm drain outfall channel was prepared based on site measurements (see page 2 in Attachment B). Based on a review of the site conditions and typical values provided by Haan et al. (1994), a Manning's roughness coefficient (n) was selected for a channel bottom of cobble. In addition to the channel characteristics and using the maximum anticipated flow as calculated above, the storm drain channel will see a maximum velocity of 8.5 ft/s, slightly less at the banks (see pages 3 and 4 of 10 in Attachment C).

The depth and velocity of flow in the main Creek channel at this site was also modeled using FlowMaster Version 6.0 for the design flow of 169 cfs, the 100 year occurrence as described in the following, Section 2.2.2. A cross section of the Creek was prepared based on site measurements and topographic data gathered by Bio-West during their Study (see Table 2 - Summary of Streambed Material, Channel Geometry, and Slope Data) for Reach LRB _R05C. Using the channel characteristics as noted and the maximum anticipated flow from the 100-year recurrence interval, the main Creek channel will see a maximum velocity of 8.7ft/s, slightly less at the banks (see pages 5 and 6 of 10 in Attachment C).

2.2.2 Creek Flow and Velocity (Site #58)

A hydrological analysis for Red Butte Creek was performed by EarthFax to establish a maximum design flow for channel repairs at Red Butte Gardens Arboretum, 1365 East Harvard Avenue, and 1109 East Harvard Avenue. This same design flow and recurrence interval will be used for design of Creek bank repairs at both Sites #37 and #58. The required supporting information and calculations to support the design storm is contained the EarthFax report, "Proposed Channel Improvements to Red Butte Creek at 1365 East Harvard Avenue" and is summarized below.

Salt Lake County maintains a stream gauging station on Red Butte Creek at 1600 East. Although stream flow data have been collected from this location since 1984, annual peak flow data have been retained by the County only since 2007. Since this is an insufficient time upon which to base long-term projections, peak flows at the subject property were determined using the regional regression equations of Kenney et al. (2008). For the area of Red Butte Creek (Geohydrologic Region 2 of Kenney et al. [2008]), the regression equations predict peak flow based on the drainage area and the mean annual precipitation in the contributing watershed.

The drainage area above the subject site was determined to be 11.54 mi^2 based on USGS topographic maps and a review of stormwater conveyance structures in the area. The mean annual precipitation in the watershed was determined to be 29.1 inches based on data downloaded from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) web site (http://prism.oregonstate.edu/products). Based on these values, the peak flows contained in Table 2 were calculated for the subject sites.

It is recognized that the regression equations of Kenney et al. (2008) were developed for natural, unregulated streams and do not strictly apply to Red Butte Creek (with a reservoir and urban land use upstream from the subject property). Although actual peak flows may be higher than predicted by these equations due to the presence of urban conditions, actual peak flows are probably much lower than predicted due to the presence of the upstream reservoir. For the sake of this analysis, it was conservatively assumed that these two factors cancel each other out. Therefore, the peak flow of 169 cfs (with a recurrence interval of 100 years) as presented in Table 2 was used for this design.

The depth of water and velocity of flow in the main Creek channel at Site #58 were modeled using FlowMaster Version 6.0 and Manning's equation (Eq. 2-1) as above for the 100 year occurrence design flow of 169 cfs. Existing Creek cross sections were prepared based on site measurements and topographic data gathered by Bio-West as compiled in Table 1 for

Reach LRB _R10 (see pages 3 and 4 of 4 in Attachment B). Using the channel characteristics as noted and the maximum anticipated flow from the 100-year recurrence interval, the main Creek channel will see a maximum velocity of 7.2 ft/s, slightly less at the banks (see pages 8 and 9 of 10 in Attachment C).

CHAPTER 3
PROPOSED REPAIRS

3.1 STORM DRAIN OUTFALL CHANNEL CONSTRUCTION PLAN (Site #37)

A plan view of the Creek with cross sections 10 feet above and below the outfall VA of 4, along with details of the outfall and proposed channel repairs are provided as pages 1 and 2 of 4 in Attachment B. The site is located on a steep, forested bank with limited access. Work will be accomplished from the west bank using small motorized equipment and hand tools/ manual labor by removing and replacing a section of chain link fence along the bank. The proposed repairs consist of the addition of approximately 2-3 cubic yards of riprap protection with the larger rock portion used to rebuild a section of the west Creek bank where the channel discharges into the Creek. Proposed repairs consist of the following:

- Key-in and rebuild the west main Creek bank with existing larger sized rock culled from the outfall channel appropriately sized hand placed riprap at the intersection with storm drain outfall channel.
- Rebuild the bottom and sides of the outfall channel with existing and imported angular riprap to provide an erosion-stable base.

Calculations required for evaluation of the Creek presented in Section 2.2.1 indicate both banks, 10 feet upstream and downstream from the outfall, are capable of containing the peak flow of 169 cfs. However, the west bank at the outfall needs to be rebuilt to avoid further erosion at the entry of the outfall channel into the Creek. Peak velocity of the Creek is approximately 8.7 ft/s. This velocity with 1H:1V bank slopes requires a D_{50} of 7-inches or Class II Riprap (see page 7 of 10 in Attachment C). However, the next larger gradation class (Class III, D_{50} = 12-inch) will be used, with the largest fraction of rock (16 to 20-inch) of the new riprap or existing rock culled from the channel to be used for repair of the Creek bank and to hold the outfall channel riprap in place. This rock will be keyed (excavated) into the channel bottom at least half of its diameter without protruding into the main channel or alter the downstream flow-line or hydraulics of the Creek. A second tier of rock will then be added with a batter of approximately 1H:1V for a bank height of 2 to 2.5 feet.

The outfall channel peak velocity of 8.5 ft/ft with a floor slope of 4H:1V requires a minimum riprap size of 7-inch (D_{50}) or equivalent County Gradation Class II rock (see page 7 of 10 in Attachment C). However, following direction from the County, the next larger gradation class (Class III, D_{50} = 12-inch) will be used for all supplemental repairs. See Salt Lake County Supplemental Specification to APWA Standard Specification 31 37 00 – Riprap or Rock Lining contained in Attachment D.

3.2 CREEK BANK REPAIR CONSTRUCTION PLAN (Site #58)

A plan view of the Creek with cross sections and details of the proposed bank repair are provided in Attachment B (see pages 3 and 4 of 4). Site #58 is located in a wooded area adjacent to a pathway accessible from the Bonneville Glen parking lot. Work in this area will be accomplished using a combination of hand tools and small mechanical equipment. The proposed repair consists of the addition of approximately 3 to 4 cubic yards of riprap to re-establish protection along a section of the north Creek bank. The proposed repair will consist of the following:

- Key-in and rebuild approximately 30 feet of the north Creek bank with appropriately sized hand placed riprap.

Calculations for the Creek hydraulics presented in Section 2.2.2 indicate that the banks are capable of containing the peak flow of 169 cfs. The peak velocity of 7.2 ft/s requires a minimum riprap size of 9-inch (D_{50}) or equivalent County Gradation Class II for rock at on a slope of 1H:1V, (see page 10 of 10 in Attachment C). Further, following direction from the County, the next larger gradation class (Class III, D_{50} = 12-inch) will be used for the bank repair. See Salt Lake County Supplemental Specification to APWA Standard Specification 31 37 00 – Riprap or Rock Lining contained in Attachment D. The largest fraction of this rock (16-inch to 20-inch) will be keyed (excavated) into the channel bottom at least half of its diameter without protruding into the main channel or alter the downstream flow-line or hydraulics of the Creek. The remainder will be hand fit into the bank behind the bottom row at a 1H:1V batter. See Salt

Lake County Supplemental Specification to APWA Standard Specification 31 37 00 – Riprap or Rock Lining contained in Attachment D.

CHAPTER 4

REFERENCES

Bio-West, Inc., February 2012. Red Butte Creek Post-Oil Release Stream Channel, Physical Habitat, and Riparian Vegetation Evaluation. Final Report. Logan, Utah.

Bio-West, Inc. 2010. Salt Lake City Riparian Corridor Study: Final Red Butte Creek Management Plan. Project report submitted to Salt Lake City Department of Public Utilities. Logan, Utah.

Brown, S.A. and E.S. Clyde. 1989. Design of Riprap Revetment. Hydraulic Engineering Circular No. 11. U.S. Department of Transportation, Federal Highway Administration. McLean, Virginia.

EarthFax Engineering, Inc., April 2012. Proposed Channel Improvements to Red Butte Creek at 1365 East Harvard Avenue. Salt Lake City, Utah

Haan, C.T., B.J. Barfield, and J.C. Hayes. 1994. Design Hydrology and Sedimentology for Small Catchments. Academic Press. San Diego, California.

Kenney, T.A., C.D. Wilkowske, and S.J. Wright. 2008. Methods for Estimating Magnitude and Frequency of Peak Flows for Natural Streams in Utah. Scientific Investigations Report 2008-5158. U.S. Geological Survey. Salt Lake City, Utah.

TABLE 1

Summary of Streambed Material, Channel Geometry, and Slope Data

Site Number	Reach Number	Measured Values at Riffle Cross-Section: Streambed Material Size Data: D16 (mm)	D50 (mm)	D84 (mm)	Percent Embedded	Channel Geometry Data: Low Flow Wetted Width (ft)	Wetted Width (ft) at 16 cfs	Local Slope (ft/ft)	Reach Data: Reach Slope (ft/ft)	Reach Length (ft)
	URB 9	12	75	164	25	10.0	10.5	0.036	0.051	2297
	URB 10	-	-	-	-	-	-	-	0.067	827
	LRB 1	6	51	111	9	6.7	16.2	0.023	0.043	281
	LRB 2	<2	12	27	5	7.0	11.3	0.009	0.053	451
	LRB 3	5	30	181	32	10.8	11.1	0.094	0.062	1041
	LRB 4A	<2	23	86	15	4.3	6.0	0.032	0.053	961
	LRB 4B	9	45	95	11	6.3	8.9	0.018	0.040	595
	LRB 4C	3	27	79	16	7.9	8.6	0.048	0.032	1294
	LRB 5A	9	42	104	6	9.9	10.4	0.054	0.055	433
	LRB 5B	12	41	104	4	8.4	10.2	0.042	0.031	1081
# 37	LRB 5C	9	42	134	16	5.8	7.6	0.028	0.037	887
	LRB 6	-	-	-	-	-	-	-	0.046	492
# 58	LRB 7	12	37	111	10	9.4	10.0	0.021	0.036	2084
	LRB 8	-	-	-	-	-	-	-	0.044	1059
	LRB 9	-	-	-	-	-	-	-	0.053	633
	LRB 10	10	32	77	3	5.8	7.4*	0.057	0.041	1449
	LRB 11	-	-	-	-	-	-	-	0.043	301

** wetted width at 10.5 cfs*

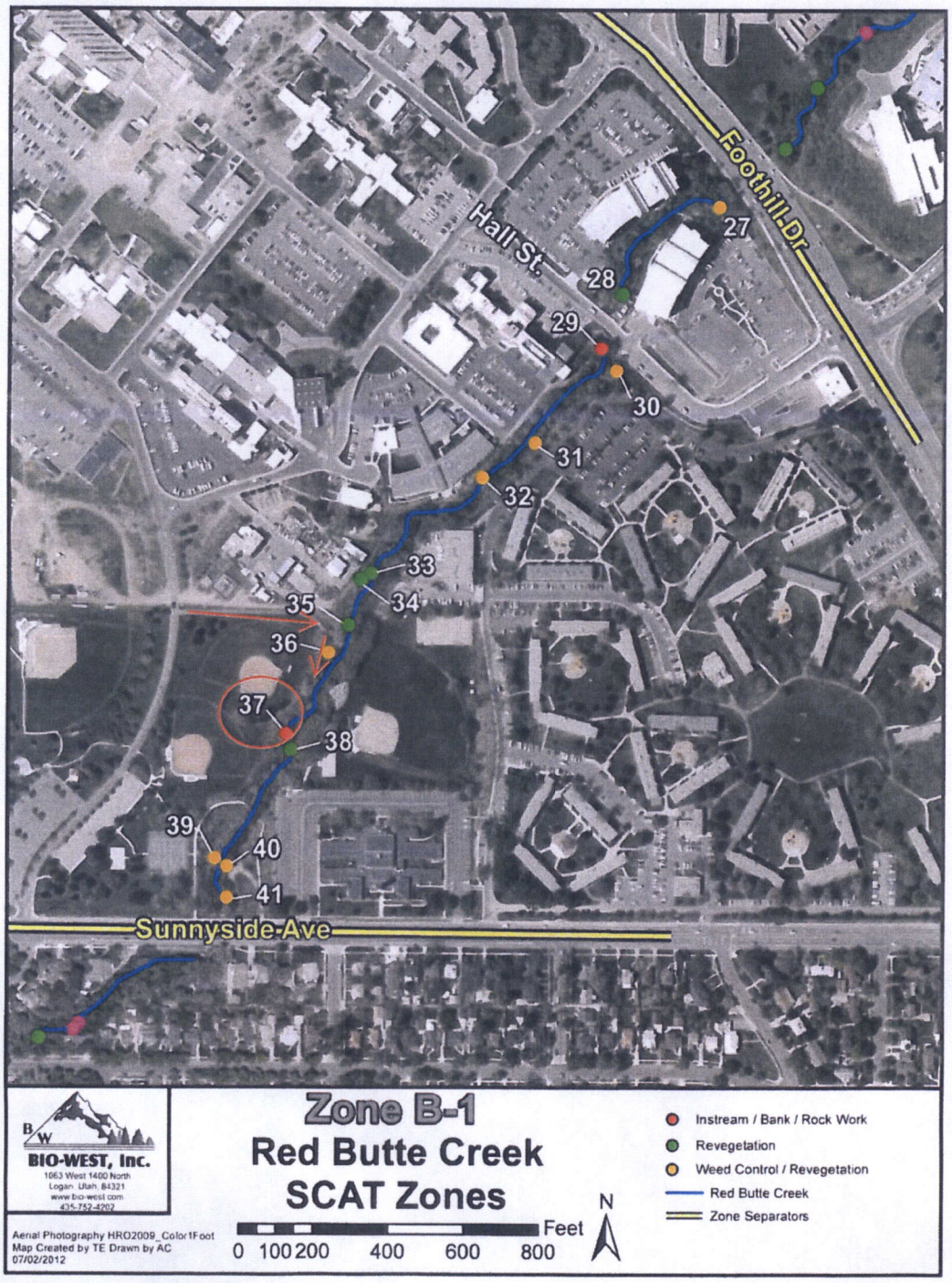
TABLE 2

Estimated Peak Flows in Red Butte Creek

Return Period (yr)	Peak Flow (cfs)
2	33
5	69
10	76
25	110
50	138
100	169

ATTACHMENT A

Photographs

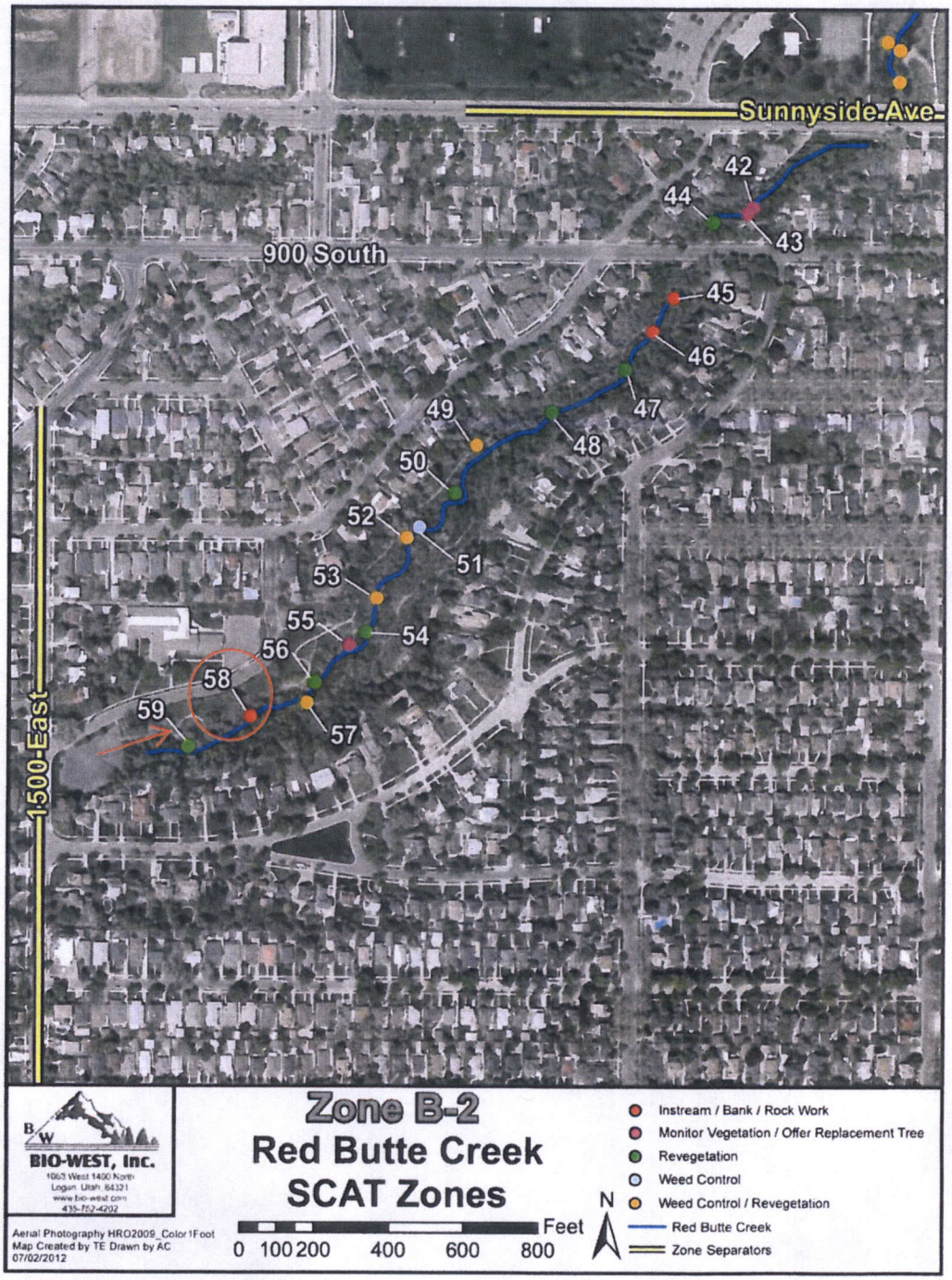


Location and Proposed Access to Church Repair Site #37 (VA Of 4 Storm Drain Outfall).

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT RBC #37 PAGE 1 OF 4
COMPUTED BRD DATE 10/08/2012

Existing conditions at Recommendation Point #37, where outfall protection repairs are proposed.



Location and Proposed Access to Church Repair Site #58 (Bank Erosion at Adjacent Trail).

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT RBC #58 PAGE 3 OF 4
COMPUTED BRD DATE 10/08/2012

BIO-WEST, Inc.

7/26/12

Eroded bank area at Recommendation Point #58.

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT RBC #58 PAGE 4 OF 4
COMPUTED BRD DATE 10/08/2012

ATTACHMENT B

DRAWINGS

Site #37 Existing Conditions Site Plan, Page 1 of 4
Site #37 Existing Conditions Cross Sections, Page 2 of 4
Site #58 Existing Conditions Site Plan, Page 3 of 4
Site #58 Existing Conditions Cross Section, Page 4 of 4

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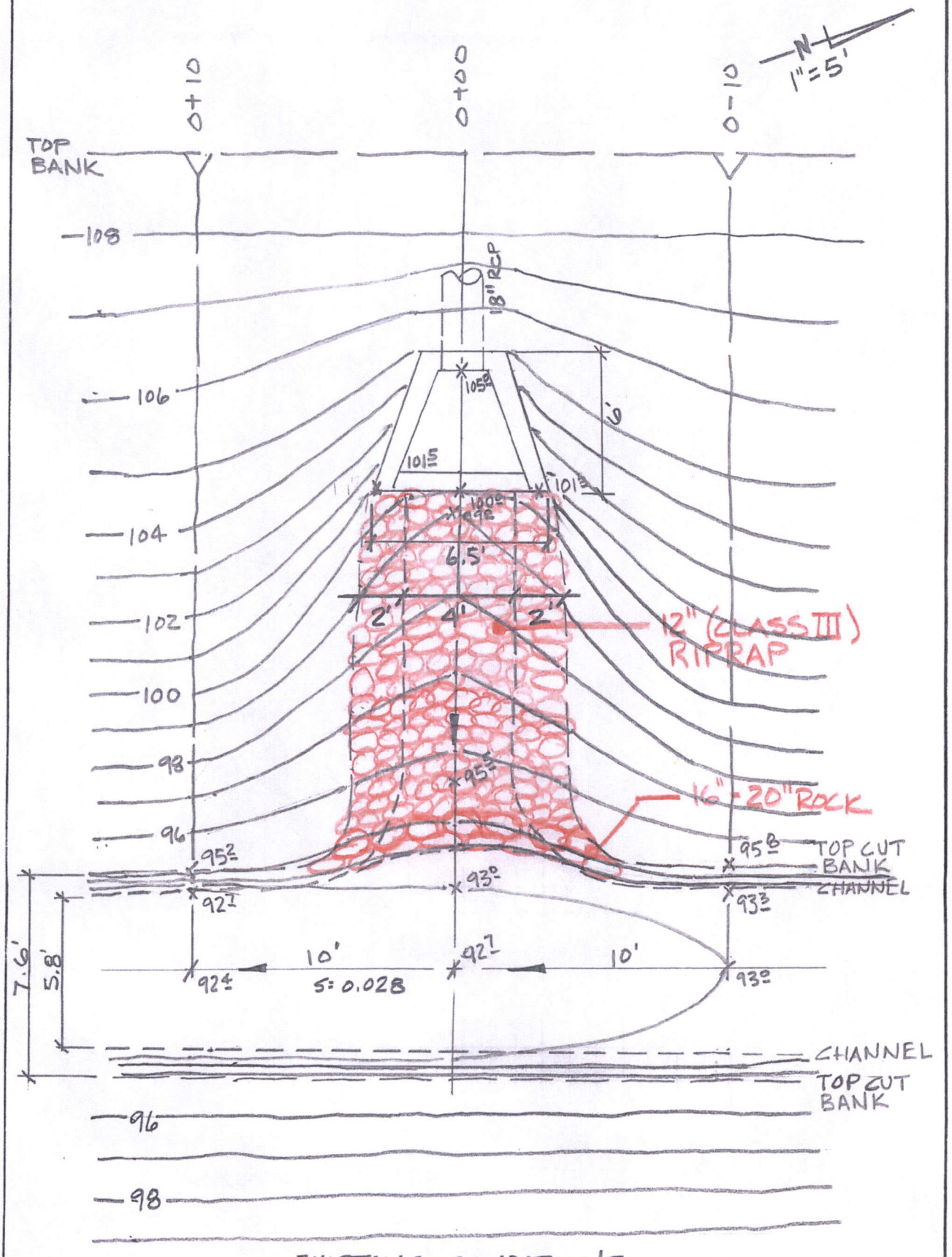
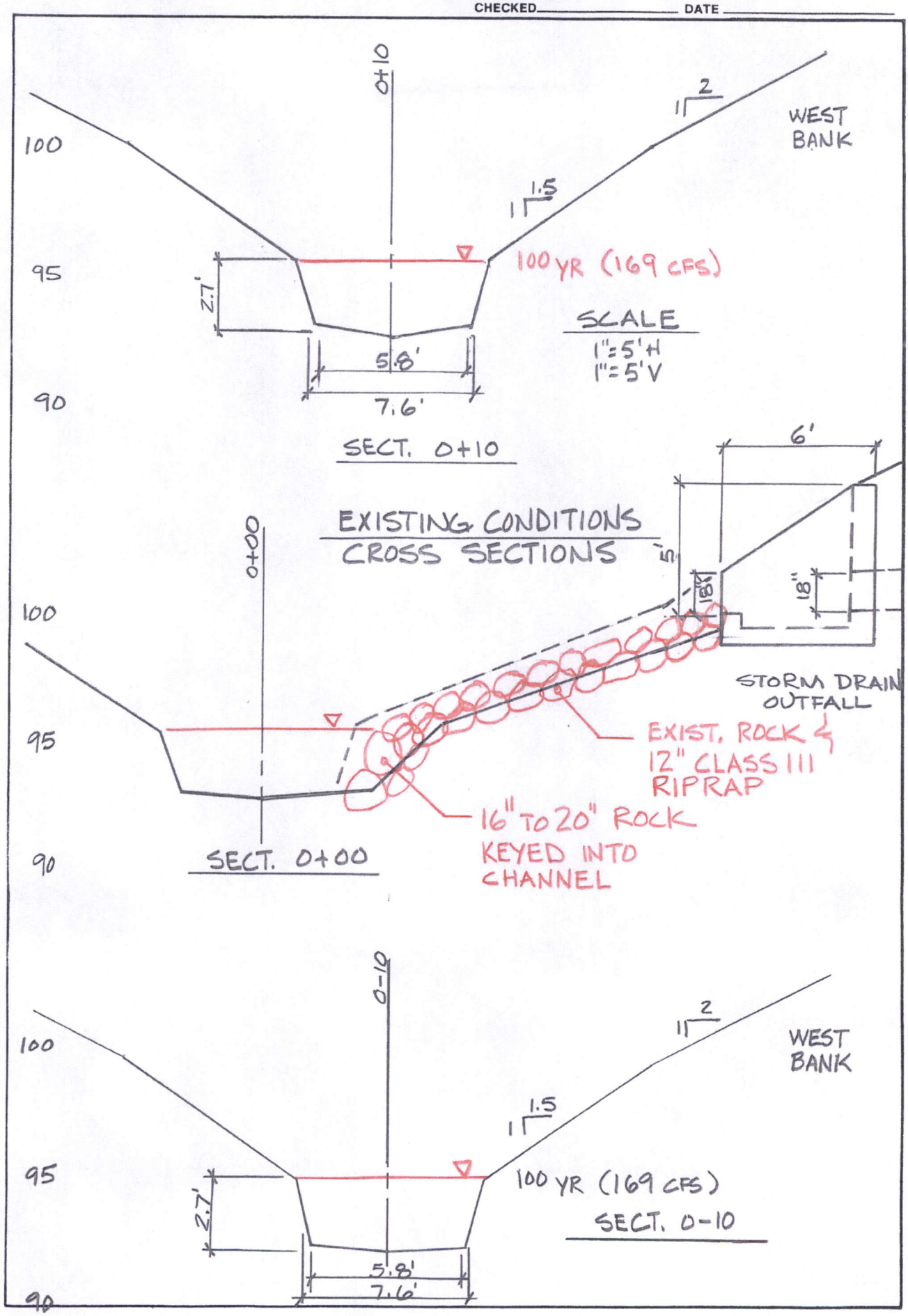
PROJECT RBC #37 PAGE 1 OF 4
COMPUTED BRD DATE 10/15/2012
CHECKED DATE



EXISTING CONDITIONS
SITE PLAN


0+10
100
95
90
2.7'
5.8'
7.6'
2
1
1.5
1
WEST BANK
100 YR (169 CFS)
SCALE
1"=5' H
1"=5' V
SECT. 0+10
EXISTING CONDITIONS
CROSS SECTIONS
0+00
100
95
90
6'
5'
18"
18"
STORM DRAIN OUTFALL
EXIST. ROCK & 12" CLASS III RIPRAP
16" TO 20" ROCK KEYED INTO CHANNEL
SECT. 0+00
0-10
100
95
90
2.7'
5.8'
7.6'
2
1
1.5
1
WEST BANK
100 YR (169 CFS)
SECT. 0-10

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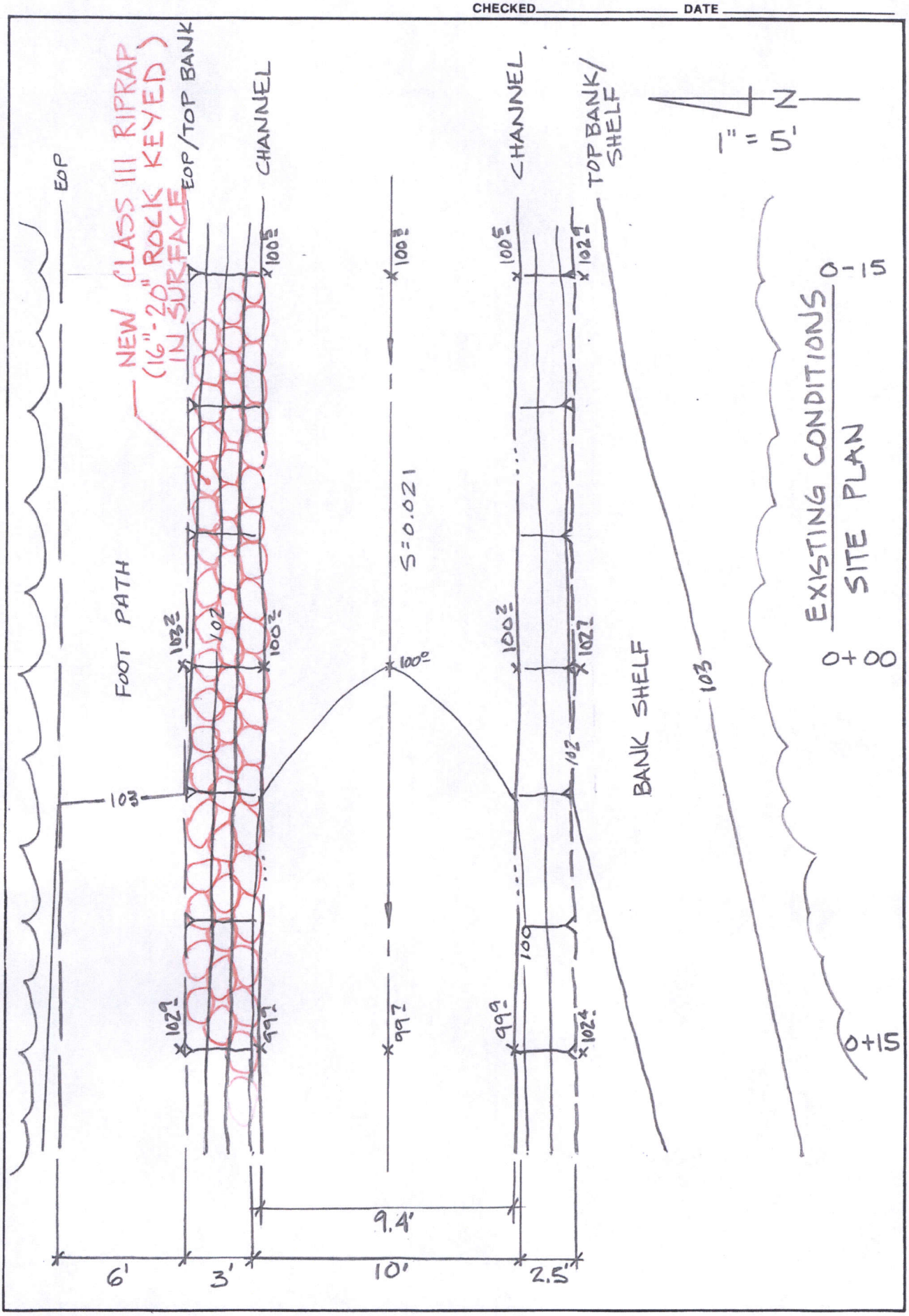
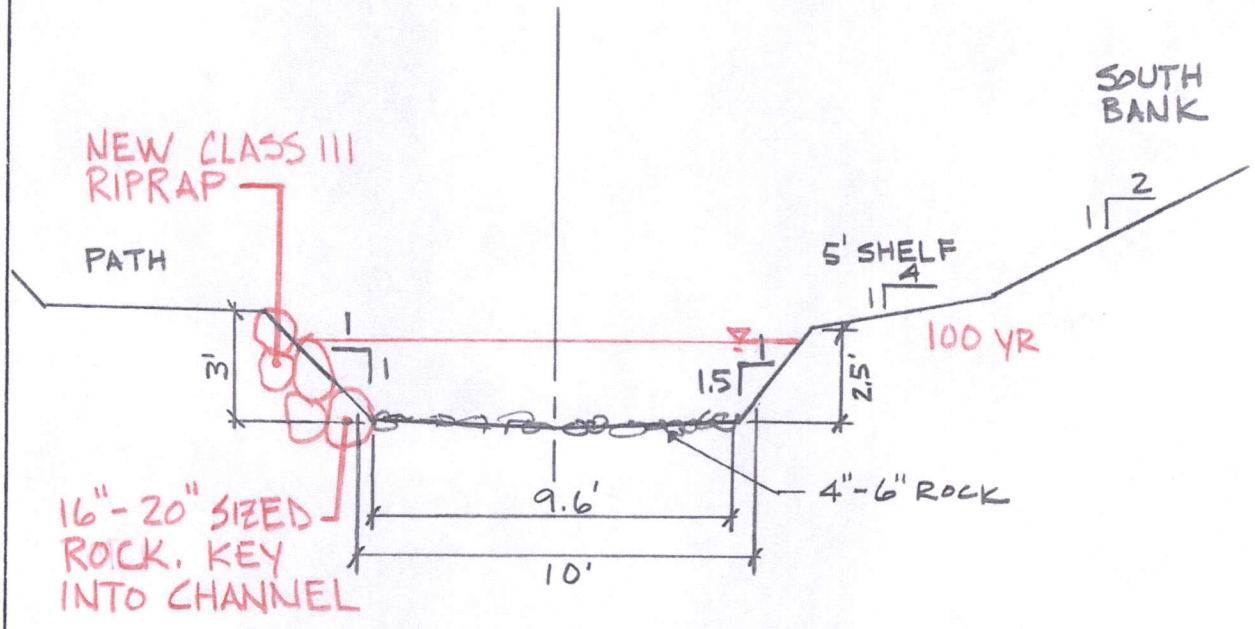




EXISTING CONDITIONS
TYPICAL CROSS SECTION

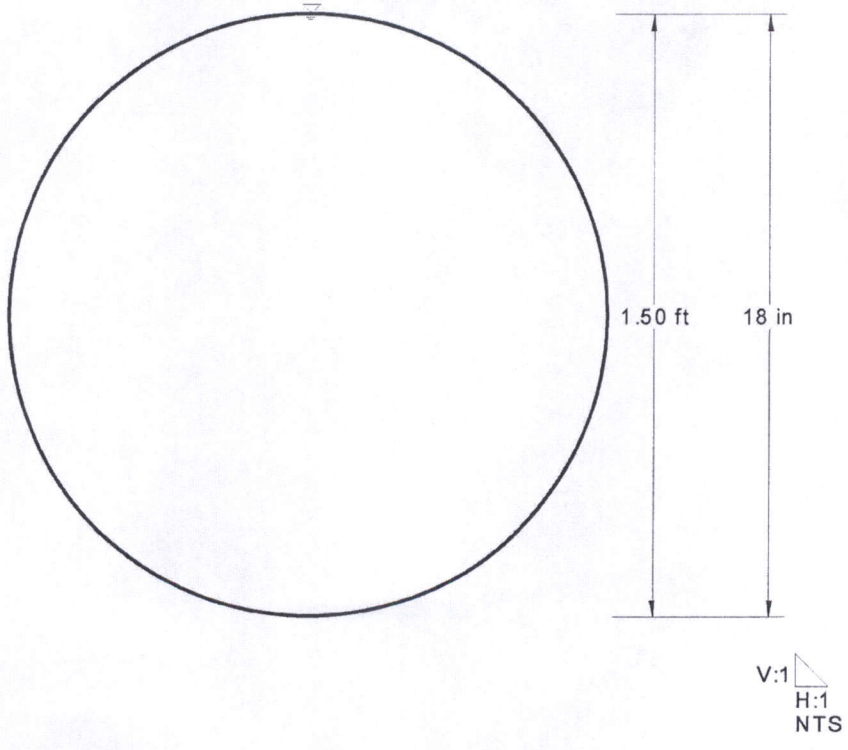
ATTACHMENT C

Hydrologic and Hydraulic Calculations

Cross Section
Cross Section for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Discharge

Section Data		
Mannings Coeffic	0.013	
Slope	012500	ft/ft
Depth	1.50	ft
Diameter	18	in
Discharge	11.74	cfs



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PROJECT RBC #37 PAGE 1 OF 10
COMPUTED BRD DATE 10/05/2012

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Discharge

Input Data		
Mannings Coeffic	0.013	
Slope	012500	ft/ft
Depth	1.50	ft
Diameter	18	in

Results		
Discharge	11.74	cfs
Flow Area	1.8	ft²
Wetted Perime	4.71	ft
Top Width	3.65e-8	ft
Critical Depth	1.30	ft
Percent Full	100.0	%
Critical Slope	0.011416	ft/ft
Velocity	6.65	ft/s
Velocity Head	0.69	ft
Specific Energ	2.19	ft
Froude Numbe	1.68e-4	
Maximum Disc	12.63	cfs
Discharge Full	11.74	cfs
Slope Full	0.012500	ft/ft
Flow Type	Subcritical	

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PROJECT RBL #37 PAGE 2 OF 10
COMPUTED BRD DATE 10/08/2012

VA of 4 Outfall Channel
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Chann
Flow Element	Trapezoidal Chann
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	280000	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	4.00	ft
Discharge	12.00	cfs

Results		
Depth	0.33	ft
Flow Area	1.4	ft²
Wetted Perim	4.92	ft
Top Width	4.65	ft
Critical Depth	0.62	ft
Critical Slope	0.032305	ft/ft
Velocity	8.53	ft/s
Velocity Head	1.13	ft
Specific Energ	1.46	ft
Froude Numb	2.73	
Flow Type	Supercritical	

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PROJECT RBC #37 PAGE 3 OF 10
COMPUTED BRD DATE 10/12/2012

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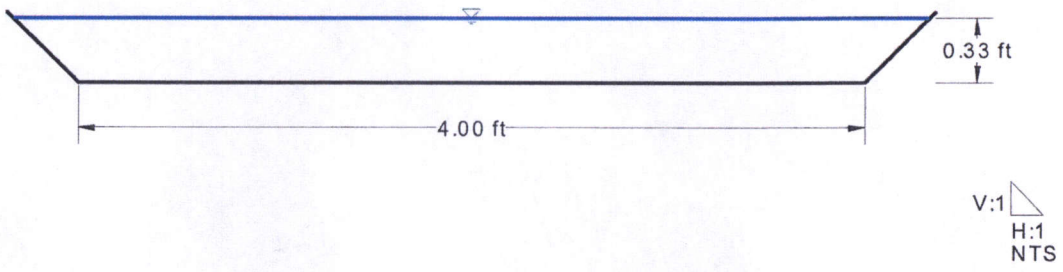
VA of 4 channel Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.040	
Slope	280000	ft/ft
Depth	0.33	ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	4.00	ft
Discharge	12.00	cfs



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PROJECT RBC #37 PAGE 4 OF 10
COMPUTED BRD DATE 10/12/2012

Creek at VA of 4 Outfall
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	028000	ft/ft
Left Side Slope	2.20	V : H
Right Side Slope	2.20	V : H
Bottom Width	5.80	ft
Discharge	169.00	cfs

Results		
Depth	2.77	ft
Flow Area	19.5	ft²
Wetted Perim	11.88	ft
Top Width	8.31	ft
Critical Depth	2.76	ft
Critical Slope	0.028221	ft/ft
Velocity	8.66	ft/s
Velocity Head	1.16	ft
Specific Energ	3.93	ft
Froude Numb	1.00	
Flow Type	Subcritical	

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PROJECT RBC #37 PAGE 5 OF 10
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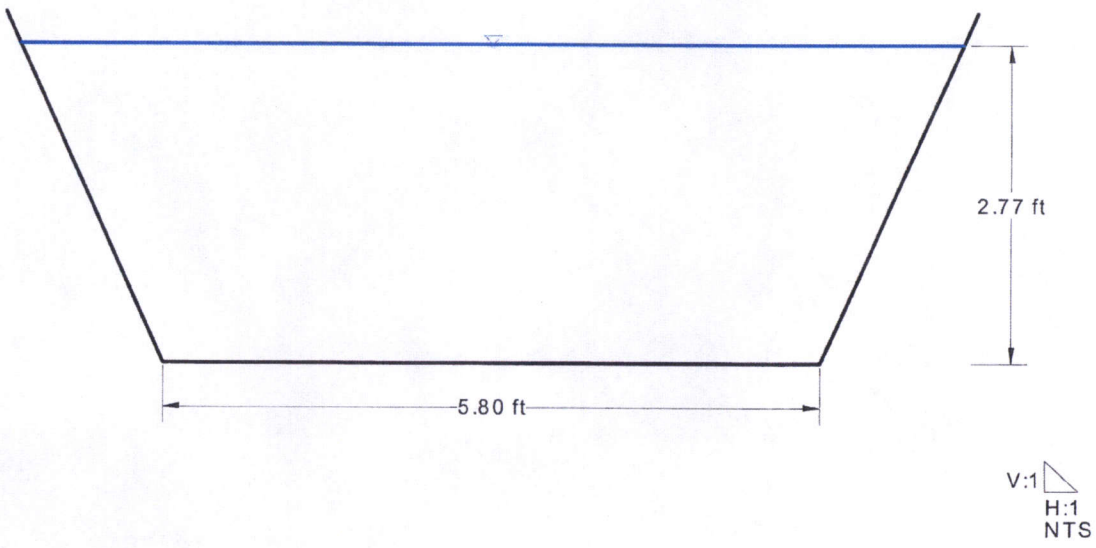
Creek Cross Section at VA of 4
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.040	
Slope	028000	ft/ft
Depth	2.77	ft
Left Side Slope	2.20	V : H
Right Side Slope	2.20	V : H
Bottom Width	5.80	ft
Discharge	169.00	cfs



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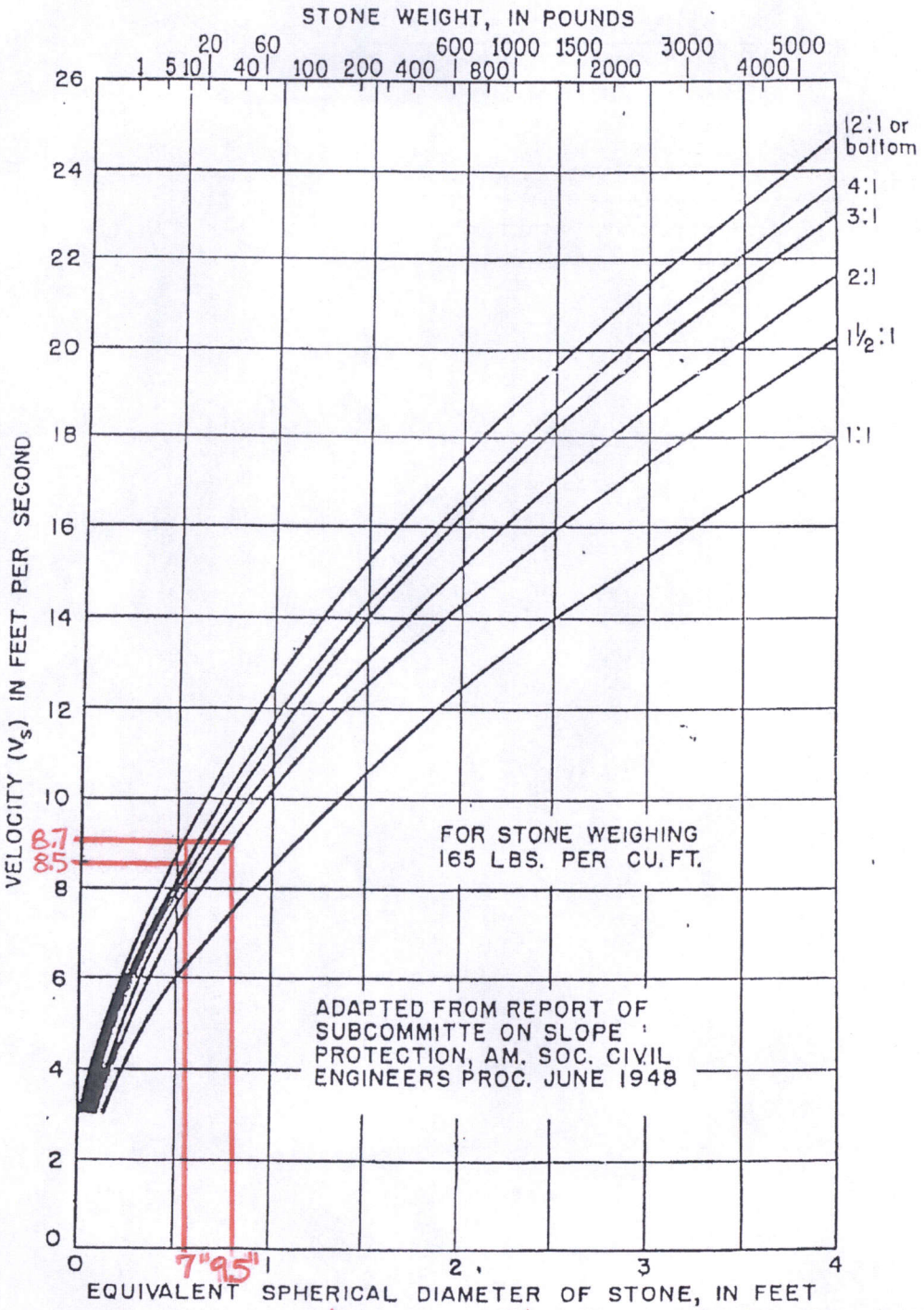

STORM DRAIN CHANNEL D_{50}=7" USE CLASS II (D_{50}=9")
CREEK CHANNEL D_{50}=9" (CLASS II, D_{50} 9") USE CLASS III, D_{50}=12"

Size of Stone that will Resist Displacement for Various Velocities and Side Slopes (U.S. Department of Transportation, 1978).

Red Butte Creek Site #58
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	RB Creek Site #:
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	021000	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	9.60	ft
Discharge	169.00	cfs

Results		
Depth	2.03	ft
Flow Area	23.6	ft²
Wetted Perim	15.33	ft
Top Width	13.65	ft
Critical Depth	1.98	ft
Critical Slope	0.022791	ft/ft
Velocity	7.17	ft/s
Velocity Head	0.80	ft
Specific Energ	2.83	ft
Froude Numb	0.96	
Flow Type	Subcritical	

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PROJECT RBC #58 PAGE 8 OF 10
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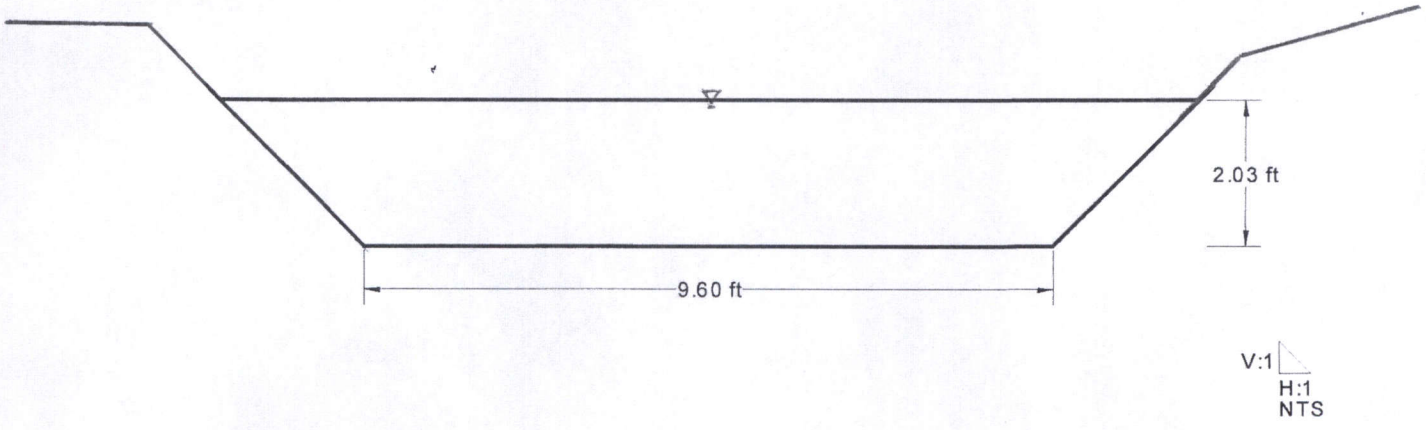
RB Creek At Site #58
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	RB Creek Site #:
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.040	
Slope	021000	ft/ft
Depth	2.03	ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	9.60	ft
Discharge	169.00	cfs



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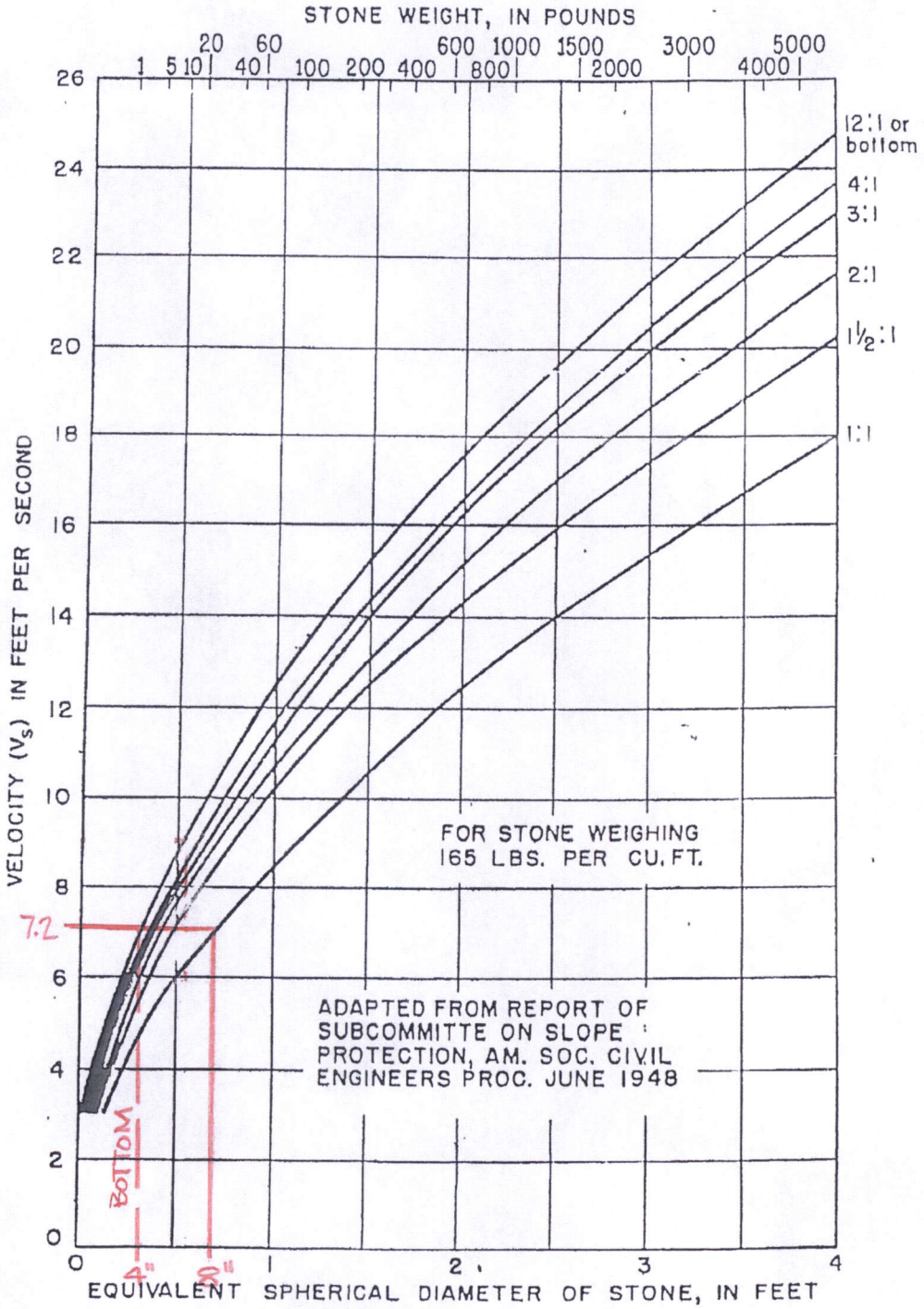

D_{50}=8", CLASS II RIPRAP (D_{50}=9")
USE CLASS III RIPRAP (D_{50}=12")

Size of Stone that will Resist Displacement for Various Velocities and Side Slopes (U.S. Department of Transportation, 1978).

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PROJECT RBC #58 PAGE 10 OF 10
COMPUTED BRD DATE 10/16/2012

ATTACHMENT D

Salt Lake County Supplemental Specification to APWA
Standard Specification 31 37 00 – Riprap or Rock Lining

SECTION 31 37 00
RIPRAP OR ROCK LINING

This specification supplements APWA Standard Specification Section 31 37 00. In cases of conflict between this specification and APWA Section 31 37 00 this specification shall govern.

PART 1 GENERAL

1.1 GENERAL

A. This section covers furnishing and placing the granular filter and loose riprap materials in accordance with these specifications and in conformity with the lines, grades, and dimensions shown on the drawings or as directed by the ENGINEER.

1.2 REFERENCES

A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. American Society for Testing and Materials (ASTM)

ASTM C-127 Specific Gravity and Absorption of Coarse Aggregate.

ASTM C-535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.3 SUBMITTALS

A. The following shall be submitted:

1. Certification from a certified independent laboratory that the riprap meets the material properties of this specification.
2. A sample of the riprap to be used for construction.

1.4 STORAGE OF MATERIALS

A. Materials shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials.

PART 2 PRODUCTS

2.1 GRANULAR FILTER

A. Granular filter sources shall be approved by the ENGINEER prior to use.

B. Concrete masonry or concrete pavement may not be used for granular filter.

C. Granular Filter shall be well graded with additional gradation requirements as follows:

GRANULAR FILTER GRADATIONS

% Smaller Than Given Size By Weight	Size (Inches)
90-100	3
35-90	¾
0-30	No. 4
0-15	No. 16
0-3	No. 200

D. The CONTRACTOR shall be responsible for obtaining (by selective mining, crushing, screening, or some other method) drainage rock will meet the specified material requirements.

2.2 LOOSE RIPRAP

A. Riprap shall consist of quarry stone which is sound and durable against disintegration under conditions to be met in handling and placing, and is hard and tenacious and otherwise of suitable quality to ensure permanency in the specified kind of work.

B. Riprap sources shall be approved by the ENGINEER prior to use. Concrete masonry or concrete pavement may not be used for riprap. Riprap shall be well graded with additional gradation requirements for riprap as follows:

LOOSE RIPRAP GRADATIONS

Riprap Designation	%Smaller Than Given Size By Weight	(Inches)	D_{50}** (Inches)
Class I	70-100	12	6
	50-70	9	
	35-50	6	
	2-10	3	
Class II	70-100	15	9
	50-70	12	
	35-50	9	
	2-10	3	

Riprap Designation	%Smaller Than Given Size By Weight	(Inches)	D_{50}** (Inches)
Class III	70-100	20	12
	50-70	16	
	35-50	12	
	2-10	4	
Class IV	70-100	25	15
	50-70	20	
	35-50	15	
	2-10	5	
Class V	70-100	30	18
	50-70	24	
	35-50	18	
	2-10	6	
Class VI	70-100	35	21
	50-70	28	
	35-50	21	
	2-10	7	
Class VII	70-100	40	24
	50-70	32	
	35-50	24	
	2-10	8	

** D_{50} = Nominal particle size

C. All stones shall be angular (no rounded rock will be permitted), each piece having its greatest dimensions not greater than three times its least dimensions. All stone shall conform to the following test requirements of the American Society for Testing and Materials Standards:

	Requirements	ASTM Standard
Specific Gravity, minimum	2.60	C-127
Los Angeles Abrasion, maximum percent	40	C-535

D. The CONTRACTOR shall be responsible for obtaining (by selective mining, crushing, screening, or some other method) loose riprap that will meet the specified material requirements.

PART 3 – EXECUTION

3.1 GRANULAR FILTER

A. Prior to placement of granular filter, the subgrades to the granular filter shall be compacted and graded to the lines and grades shown on the drawings.

B. Granular filter shall generally be placed starting at the lowest elevations and working upward. The surface shall be leveled as necessary, to produce a reasonably uniform appearance and the required thickness.

3.2 LOOSE RIPRAP

A. Prior to placement of loose riprap, the granular filter shall be placed and graded to the lines and grades shown on the drawings.

B. Riprap shall generally be placed starting at the lowest elevations and working upward. Riprap shall be placed to the minimum thickness designated on the drawings and shall be positioned in such a manner that will provide uniform distribution of the various sizes of stone and produce a well-keyed mass of rock with the least practical amount of void space. The surface shall be leveled as necessary, to produce a reasonably uniform appearance and the required thickness.

END OF SECTION

February 4, 2013

EarthFax
Engineering, Inc.
Engineers/Scientists
7324 So. Union Park Ave.
Suite 100
Midvale, Utah 84047
Phone 801-561-1555
Fax 801-561-1861
www.earthfax.com

Mr. Chuck Williamson
Stream Alteration Specialist
Utah Department of Natural Resources
Division of Water Rights
1594 West North Temple, Suite 220
Salt Lake City, UT 84114

Subject: Red Butte Creek Repair Project at Sites No. 37 and No.58

Dear Mr. Williamson:

Attached is a copy of the Design Study Report for repair of two storm drain inlets into Red Butte Creek on LDS Church property in Salt Lake City, Utah. Also enclosed is the Joint Permit Application Form with a check for the required application fee.

This report contains the calculations, plan and cross section drawings, and work plan for construction of riprap improvements to the Creek bank and inlet channels. Please note this report addresses the following:

- 100 year occurrence high flow used in the previous repair work on the Creek has been used for the design and is shown in the cross sections
- Stationing and elevations are relative based at the site of the proposed work
- Existing and proposed cross sections both above and below the inlets
- Rock (riprap) size is specified from the County specifications, one step larger than calculations require for both the bank and inlets
- Some riparian area vegetation will be used for additional bank stabilization at the weir location

We appreciate your help with the permitting of this project to expedite the construction. Please let us know if you have any further questions.

Sincerely,

Brad Derrick

EarthFax Engineering
Bradley R. Derrick, P.E.

February 12, 2013

Mr. Chuck Williamson
Stream Alteration Specialist
Utah Department of Natural Resources
Division of Water Rights
1594 West North Temple, Suite 220
Salt Lake City, UT 84114

EarthFax
Engineering, Inc.
Engineers/Scientists
7324 So. Union Park Ave.
Suite 100
Midvale, Utah 84047
Phone 801-561-1555
Fax 801-561-1861
www.earthfax.com

Subject: Red Butte Creek Repair Project at Sites No. 37 and No.58

Dear Mr. Williamson:

Please find the enclosed check as required for the permit fee for restoration repairs to Red Butte Creek at the Veterans Administration Hospital in Salt Lake City, Utah.

We appreciate your help with the permitting of this project. Please let us know if you have any further needs concerning this project.

Sincerely,

Brad Derrick

EarthFax Engineering
Bradley R. Derrick, P.E.